DOE Workshop on Rulemaking to Designate Fischer-Tropsch Diesel Fuels as EPAct Alternative Fuels

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Workshop Represents

- Part of first formal step in the rulemaking process (technical review and evaluation).

- Opportunity to get input from stakeholders and public on key technical areas before going forward with Notice of Proposed Rulemaking (NoPR).

Sec. 301(2) of EPAct

- Lists certain fuels as alternative fuels

- Authorizes DOE to designate alternative fuels ***by rulemaking*** in addition to those listed in statute

DOE may designate a fuel if it meets 3 criteria of sec. 301(2)

- Substantially nonpetroleum
- Substantial energy security benefits
- Substantial environmental benefits

Fischer-Tropsch Processes

- Feedstock reformed into “synthesis gas” - H_2 and CO
- Synthesis gas reacted into hydrocarbon streams including waxes, liquids, and/or gases
- Reactor output refined with conventional refining techniques into final products including distillates

Rulemaking on FTD

- Considerable interest in FTD by fuel industry and environmental community
- DOE funding FTD research
- More than a dozen plants existing, announced, or under discussion - numerous producers
- DOE received rulemaking petitions from Rentech, PetroSA, and Syntroleum
- Rulemaking limited to diesel fuel made from natural gas, including landfill gas

Initial Technical Review

- Petitioners' data reviewed along with other information by regulatory team and national laboratory partners.
- NREL studied criteria emissions data.
- Argonne studied GHG emissions and process efficiencies using its GREET model.
- Technical evaluation documents prepared and put into docket for public review and comment.

Generally it was found

- FTD could provide environmental benefits **<u>if</u>**
  - fuel parameters defined adequately
  - GHGs not increased significantly
  - other concerns addressed
- Existing emissions studies indicate FTD fuel properties likely to result in tailpipe emission reductions, particularly NOx

And…

- The fuel is substantially non-petroleum
- Substantial energy security benefits derived from
  - Abundant, geographically diverse feedstock
    - Longer supply horizon than petroleum
    - Location of existing and planned plants is diverse
  - Natural gas used would be “new” energy production or would otherwise be reinjected - net gain in nonpetroleum energy produced

But…FTD production is less energy efficient than petroleum refining

- Range of energy efficiency losses for different process configurations
- Argonne report highlights these findings
- DOE requesting comment on options for energy efficiency, including:
  - Designate FTD without process efficiency control based on other energy security benefits
  - Set a process energy limit (energy use per barrel of fuel produced)

Generic FTD designation

- DOE leaning toward generic designation for FTD
- DOE seeking recommendations on appropriate parameters for FTD included as EPAct fuel.
  - production process parameters
  - fuel specifications

Balancing the Decision

- DOE needs input on how to balance factors and criteria in making fuel rulemaking decisions. (e.g., how should beneficial attributes be weighed against detrimental attributes)?

DOE Analyzing Several Environmental Factors

- Greenhouse gas emissions
- Criteria pollutant emissions
- Toxic pollutant emissions
- Impacts to groundwater, marine environment as related to biodegradation and ecotoxicity

FTD Appears Beneficial for Criteria Pollutant Emissions

- Data and analysis in the NREL study suggest:
  - Reductions relative to current and future petroleum-based diesel fuels
  - NOx reductions of 6-20% in pre-1998 engines
  - Expect lower PM, HC and CO emissions

FTD Fuel Qualities

- Near zero sulfur
- Very high cetane
- Aromatics near zero (except PetroSA)
- Almost wholly n-paraffins (except PetroSA or if treated, e.g. isomerized)
- Low density

Specific FTD Fuel Qualities Determined by

- Plant specific factors
- Operating conditions - e.g. temp., pressure
- Post synthesis refining choices

Specific FTD Fuel Qualities Determined (cont.)

- ***Catalyst/reactor design can influence reactor output but DOE has seen no evidence that final fuel quality determined significantly by proprietary technologies***

- **<u>But</u>** … PetroSA COD different from straight FTD

FTD Emissions Studies

- No studies of FTD in AFVs
- No real studies with emission control devices
- Very little data comparing FTD to ULSD
- Little data with post-1998 engines
- Range of models/vehicle characteristics represented but not statistically representative of vehicle population

FTD Emissions Studies (cont.)

- Large emissions reductions w/FTD vs. no. 2 diesel (500ppm S) in pre-98 engines
- Some studies statistically significant for individual vehicle/tests
- Statistically significant (non-zero) reduction for pre-1998 engines
- No statistically significant quantitative estimates of emission reductions

Test Fuels Used in FTD Emissions Studies

- **Not necessarily representative of future in-use FTD.**
- Detailed fuel specifications generally not provided
- Not clear if in conformity with ASTM D-975
- Some apparently near 100% n-paraffin (possible cold flow problems and elastomer shrinkage w/ zero aromatics)

Fuel Property Emissions Studies

- EPA's diesel emissions model has not yielded adequate results to date
- Aromatics reduction from 30 to 10% with cetane increase of 30 pts gives statistically significant NOx reduction of 6-20% (NREL)
- Cetane increases above 50 appear not to provide NOx reductions in post-1998 engines.

Fuel Property/emissions (cont.)

- Most recent data (since NREL competed its FTD study) indicates that weight percent of hydrogen may be more important than cetane.
- Higher hydrogen content seems to reduce NOx (and PM) emissions across engine technologies, unlike cetane.
- More data needed on FTD emissions with test/control fuel composition identified.

DOE seeking comments on fuel parameters for generic designation

Example:

- Aromatics max. 1-15%?
  - Will low end of range cause materials compatibility problems?
  - Should a polyaromatic content be included in addition to or in lieu of total aromatics?
- Cetane min. 53-75? And/or hydrocarbon composition limits?
- Sulfur range 5-15ppm?
- Hydrogen content?
- Conformity to ASTM D-975-02?

GHG Emissions

- Stand alone production of FTD results in nearly twice as many GHGs as ULSD
- GHGs from combustion in vehicles 7% lower for FTD than ULSD
- Limited data indicates FTD provides 4% greater per-btu mileage than conventional diesel
- Per mile GHGs appear 2-13% higher for FTD than conventional diesel, with average value of 8% higher

GHG Emissions (cont.)

- FTD GHGs vary by production technology, site-specifics, operating conditions, etc.
- FTD plants with steam and/or electricity export could have lower per-mile GHGs than conventional diesel
- If FTD made from gas otherwise flared, GHG reductions would be substantial,

GHG Control Options

- No control - assume GHG increases small enough to be acceptable in light of criteria pollutant reductions
- Maximum GHG emissions per unit of fuel output
- Designate only FTD from plants with steam or electricity exports or using flared gas

Other Environmental Findings

- FTD exhaust **probably** significantly less toxic than conventional diesel exhaust
  - Limited data identified, more sought
- FTD biodegradation probably comparable to conventional diesel
  - Data also limited, more sought

Oxygenate Issues

- Oxygenates often co-produced with FTD. Can be reduced to *de minimis* levels with post-synthesis refining
- Specific oxygenates not identified in literature; health effects not established
- Comment requested on *de minimis* limit of 0.25% oxygenates except for those on which Tier 1&2 data submitted to EPA

Additive Issues

- Diesel fuels typically employ variety of additives for various purposes
- FTD properties superior to conventional diesel in some regards, poorer in lubricity (others?)
- DOE seeks comment on whether specific additive requirements should be included in a possible designation of FTD as alternative fuel

Title V and Title III Fleet Programs

- Main EPAct requirements met with light-duty AFV acquisitions
- Conventional diesel vehicles are not AFVs, irrespective of FTD use
- FTD meets fuel use requirements for fuel providers and federal fleets and petroleum reduction requirements
- Might consider vehicles specifically designed to operate on FTD as AFVs

FY 2001 Appropriations Act

- Added language to EPAct definition by inserting after "…*natural gas*" "*,including liquid fuels produced domestically from natural gas*."
- Would allow all domestic GTL products even those environmentally detrimental
- DOE bound by statute until Congress amends - all domestic GTL considered AF

Review of Themes and Issues

- Generic designation
  - Fuel specification ranges to assure emissions benefits and process energy limits for efficiency?

- Benefits vs. detriments
  - How do GHG and criteria emissions balance in rulemaking? Should there be GHG standards?

Themes continued:

- Data and information gaps
- Conventional vehicles not AFVs for Title III and V fleet programs, irrespective of FTD use
- All domestic GTL treated as alt. fuel per Appropriations Act until Congress amends statute

Next Steps

- Review workshop proceedings and comments (comment period ends 11/15/02).
- Make decision on designation
- If positive write NOPR (spring ’03)
- Comment period (90 days)
- OMB review (90 days)
- Final (winter ’04)